

Life Science (Sem V)
Discipline Specific Elective Botany
Cell and Molecular Biology
Theory
Lectures=60

26/7/17
Shubh Tyagi

Unit 1: Techniques in Biology

(8 Lectures)

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

Unit 2: Cell as a unit of Life

(2 Lectures)

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

Unit 3: Cell Organelles

Mitochondria- Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. (4 Lectures)

Chloroplast-Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. (4 Lectures)

ER, Golgi body & Lysosomes:-Structures and roles.

(6 Lectures)

Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis.

(2 Lectures)

Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

(4 Lectures)

Unit 4: Cell Membrane and Cell Wall

Daniell and Davson (8 Lectures)

The functions of membranes; Models of membrane structure (Overton, ~~Langmuir~~, Robertson, Singer & Nicolson); The fluidity of membranes; Membrane proteins (3 types) and their functions (brief account); Carbohydrates in the membrane (brief account); Faces of the membranes; Selective permeability of the membranes; Cell wall (Primary & Secondary).

Unit 5: Cell Cycle

(4 Lectures)

Overview of Cell cycle, Mitosis and Meiosis; Molecular controls (in brief from Karp).

Unit 6: Genetic material

(7 Lectures)

DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.

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DNA replication (Prokaryotes and differences from eukaryotes): bidirectional replication, semi-conservative, semi discontinuous RNA priming, (theta) mode of replication, replication of linear, ds-DNA, replicating the 5' end of linear chromosome including replication enzymes (in brief).

Unit 7: Transcription & Translation

(7 Lectures)

Transcription (Prokaryotes and differences from eukaryotes); Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and differences from eukaryotes), genetic code.

Unit 8: Regulation of gene expression

(4 Lectures)

Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes (brief account).

Practicals

1. To study prokaryotic cells (*E.coli*), viruses (TMV, T2 phage), eukaryotic cells (Plant and Animal cell) with the help of electron micrographs.
2. Study of the photomicrographs of cell organelles (Nucleus, Mitochondria, Chloroplast, Golgi Complex, ER, Lysosomes).
3. To study the structure of plant cell through temporary mounts (*Allium/ Crinum*).
4. To study the structure of animal cells by temporary mounts of squamous epithelial cell and nerve cell through photograph.
5. To study striated muscle fiber through photograph.
6. To prepare temporary stained preparation of mitochondria from cheek epithelial cells using vital stain Janus green.
7. Study of mitosis (temporary mounts) and meiosis (permanent slides).
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Demonstration of plasmolysis and deplasmolysis on *Rhoeo* leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry in *Allium*.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp), Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
13. Study DNA packaging by micrographs.
14. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

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Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. 4. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. 6. 4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the
7. Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

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Amrita Rawi

Guidelines for Practicals
III year Life Science Cell & Molecular Biology
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1. Perform the given experiment out of the following by draw of lots: (8 marks)
 - i. To study the effect of temperature (4°C, RT, 50°C, 80°C) on membrane permeability using beet root.
 - ii. To study the effect of organic solvent (0%, 30%, 50%, 80%) on membrane permeability using beet root.
 - iii. To measure cell size by micrometry in *Allium* epidermis (length/ breadth)
Requirements: 1 mark
Principle: 2 marks
Performance & Observation: 2 marks
Result & Discussion: 2 marks
Precautions: 1 mark
2. To show one stage of mitosis through temporary squash preparation of *Allium* root tips. (4 marks)
Preparation: 2 marks
Identification: 1 mark
Diagram: 1 mark
3. Setup: Demonstration of Dialysis/ Plasmolysis (only 2 questions to be asked) (3 marks)
4. Spots (Five) (2 marks each; Diagram ½ mark, identification ½ mark, comments 1 mark) (10 marks)
 - i. E.M. Cell (1)
 - ii. E.M. Cell Organelle (1)
 - iii. Stage of meiosis / karyotype (1)
 - iv. Polytene/ Lampbrush chromosome (1)
 - v. DNA packaging/ NPC (1)
5. CE (25 marks)
Test: 10 marks
Lab records: 10 marks
Attendance: 5 marks

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